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CORROSION TESTS WITH MIL-H-83282 AND MIL-H-6083 AIRCRAFT HYDRAU--ETC(U)
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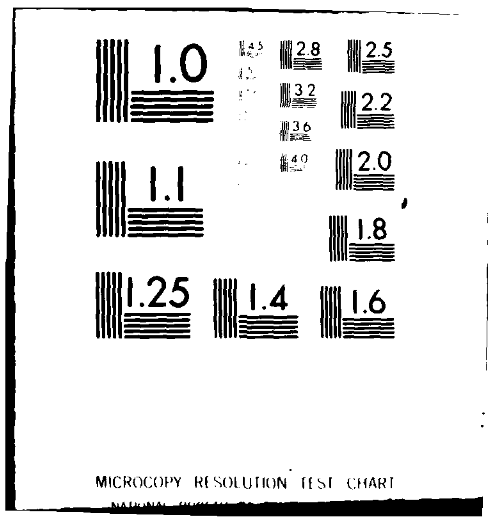
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MICROCOPY RESOLUTION TEST CHART

REPORT NO. NADC-81301-60

(12)

CORROSION TESTS WITH MIL-H-83282 AND MIL-H-6083 AIRCRAFT HYDRAULIC FLUIDS

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Aircraft and Crew Systems Technology Directorate
NAVAL AIR DEVELOPMENT CENTER

25 JANUARY 1982

Final Report
AIRTASK A320320A/001B/IF61542000
Work Unit No. ZM501

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Corrosion tests were performed to determine whether MIL-H-83282 hydraulic fluid could be used in place of MIL-H-6083 preservative fluid in Intermediate Maintenance Activity (IMA) and NAVAIREWORKFAC hydraulic test stands. The results presented in this report show that MIL-H-83282 can not be considered as a suitable alternative fluid.

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BACKGROUND

In FY-78, the conversion of naval aircraft from petroleum based MIL-H-5606 hydraulic fluid to synthetic hydrocarbon/ester based MIL-H-83282 fire-resistant hydraulic fluid was initiated on an attrition basis. Recent (FY-80) informal random sampling of aircraft hydraulic system fluids by Naval Safety Center (NAVSAFECEN) personnel and subsequent flash point testing by Naval Air Rework Facilities (NAVAIREWORKFAC) indicate that a large number of aircraft are still in operation with high levels of MIL-H-5606/MIL-H-6083 preservative fluid. One reason for this condition is the installation of replacement hydraulic components filled with MIL-H-6083 fluid, which is used in ground test stands. In order to help alleviate this problem, it was recommended that an investigation be undertaken to determine the feasibility of converting all Intermediate Maintenance Activities (IMA) and NAVAIREWORKFAC hydraulic test stands to MIL-H-83282 until a satisfactory fire resistant preservative fluid is developed. The Naval Air Development Center (NAVAIRDEVCEN) was tasked under AIRTASK A320320A/001B/1F61542000, Work Unit No. ZM501, to evaluate the corrosion preventive properties of MIL-H-83282 fluid and to determine the feasibility of using this fluid in place of MIL-H-6083 in test stands and for storage.

EXPERIMENTAL

A simplified static corrosion test was utilized in this program. Glass vials 85 x 23 mm (Arthur H. Thomas Catalog Number 9710-D72) were filled with either 3 ml of test fluid for half immersed metal specimens or 10 ml of test fluid for totally immersed metal specimens. A micro-syringe was used to add distilled water when required; the weight being determined on an analytical balance ($\pm$ .2 mg). Metal specimens consisting of AISI-52100 steel measuring approximately 25 x 13 x 1.5 mm were polished with 240, and 2/0 emery paper, brushed in solvent, rinsed in fresh solvent, air dried and weighed. The metal specimens were then placed in the vials as shown in Figure 1. The vials were capped hand tight and weighed. One set of vials (12) was kept at room temperature 25 $\pm$ 3°C (77 $\pm$ 5°F) while the other set (12) was placed in an air circulating oven at 71 $\pm$ 1°C (160 $\pm$ 2°F). After 500 hours, the vials containing the test fluids and metal specimens were weighed. The metal specimens were then removed, washed in solvent, air dried, weighed and examined visually and microscopically for signs of corrosion.

In this investigation, a two-level factorial design pattern was employed (Table 1). After determining the nature of independent variables to be investigated, in this case three; namely, temperature, added water concentration and degree of metal strip immersion in this test fluid, a low and high value for each variable was selected. Since there are three independent variables, a cubic yates order was employed. This established the basic number of tests to be performed, eight, in order to thoroughly investigate this system. Since triplicate results were desired, a total of 24 tests were performed on each fluid.

The water content of the hydraulic fluids used in these experiments was 129 ppm for MIL-H-83282 and 461 ppm for MIL-H-6083.

RESULTS

The results of this investigation are presented in Tables 2 and 3. The following parameters are tabulated; Added water concentration, metal strip immersion, system weight change, 52100 steel strip weight change and degree of corrosion of the metal strip. The last property is defined on the following scale:

Designation	Degree of Corrosion
None	No evidence of corrosion.
Slight	No more than five isolated corrosion spots.
Moderate	Small areas of corrosion present.
Heavy	Large areas of corrosion present.

With MIL-H-83282 the most severe corrosion occurred for totally immersed specimens and an added water concentration of approximately 1000 ppm at 71°C (160°F). The corresponding test at room temperature showed moderate signs of corrosion. The balance of the tests showed no signs of corrosion except for test number 12 where only slight corrosion was found. With MIL-H-6083, no sign of corrosion was observed for any of the test conditions.

Comparing the metal strip weight changes, it is interesting to note that with MIL-H-83282 values ranged from -24.3 mg to +5.5 mg while with MIL-H-6083 these values ranged from -0.8 mg to +1.5 mg indicating greater metal surface activity for MIL-H-83282 compared to MIL-H-6083.

CONCLUSIONS

It has been determined that MIL-H-83282 hydraulic fluid is unacceptable as a replacement fluid in applications requiring the use of MIL-H-6083 hydraulic fluid.

RECOMMENDATIONS

It is recommended that the use of MIL-H-6083 hydraulic fluid be continued until a suitable replacement fluid is developed.

TABLE I. EXPERIMENTAL DESIGN

Variable	Low Value	High Value
X_1 = Temperature ^oC (^oF)	25 (77)	71 (160)
X_2 = Added H_2O Concentration, ppm	0	1,000
X_3 = Metal Specimen Immersion	Half	Total

Run	X_1	X_2	X_3
1, 9, 17	25 (77)	0	Half
2, 10, 18	71 (160)	0	Half
3, 11, 19	25 (77)	1000	Half
4, 12, 20	71 (160)	1000	Half
5, 13, 21	25 (77)	0	Total
6, 14, 22	71 (160)	0	Total
7, 15, 23	25 (77)	1000	Total
8, 16, 24	71 (160)	1000	Total

TABLE 2. RESULTS OF CORROSION TESTS WITH MIL-H-83282 AFTER 500 HOURS

Property	Temperature					
	25°C (77°F)			71°C (160°F)		
	Run 1	Run 9	Run 17	Run 2	Run 10	Run 18
Added H_2O, ppm	0	0	0	0	0	0
Metal Strip Immersion	Half	Half	Half	Half	Half	Half
System Weight Change, mg	+5.0	+7.6	+7.8	-136.7	-130.1	-150.2
52100 Steel Strip Weight Change, mg	-13.3	-4.3	+4.5	+2.4	+2.7	+3.0
Degree of Corrosion	None	None	None	None	None	None
	Run 3	Run 11	Run 19	Run 4	Run 12	Run 20
Added H_2O, ppm	1245	981	1453	~1000	1382	1496
Metal Strip Immersion	Half	Half	Half	Half	Half	Half
System Weight Change, mg	+2.6	+3.4	+4.1	-140.7	-143.9	-154.1
52100 Steel Strip Weight Change, mg	-24.3	-8.3	+5.5	+2.7	+2.7	+2.9
Degree of Corrosion	None	None	None	None	Slight	None
	Run 5	Run 13	Run 21	Run 6	Run 14	Run 22
Added H_2O, ppm	0	0	0	0	0	0
Metal Strip Immersion	Total	Total	Total	Total	Total	Total
System Weight Change, mg	+8.2	+8.6	+8.9	-146.7	-123.6	-124.5
52100 Steel Strip Weight Change, mg	+1.3	-4.1	+4.3	+7.8	+3.2	+2.2
Degree of Corrosion	None	None	None	None	None	None

TABLE 2. RESULTS OF CORROSION TESTS WITH MIL-H-83282
AFTER 500 HOURS (CONTINUED)

	Temperature					
	25°C (77°F)			71°C (160°F)		
Property	Run 7	Run 15	Run 23	Run 8	Run 16	Run 24
Added H_2O, ppm	1017	1046	995	963	924	1093
Metal Strip Immersion	Total	Total	Total	Total	Total	Total
System Weight Change, mg	+3.1	+0.4	-0.2	-122.1	-155.3	-166.8
52100 Steel Strip Weight Change, mg	+1.5	-7.8	+4.3	+2.8	+3.2	+2.7
Degree of Corrosion	Moderate	Moderate	Moderate	Heavy	Heavy	Moderate

TABLE 3. RESULTS OF CORROSION TESTS WITH MIL-H-6083 AFTER 500 HOURS

	Temperature					
	25° C (77°F)			71° C (160°F)		
Property	Run 1	Run 9	Run 17	Run 2	Run 10	Run 18
Added H_2O, ppm	0	0	0	0	0	0
Metal Strip Immersion	Half	Half	Half	Half	Half	Half
System Weight Change, mg	+0.9	+1.0	+2.7	-143.6	-147.1	-139.9
52100 Steel Strip Weight Change, mg	0	-0.4	0	0	-0.4	-0.6
Degree of Corrosion	None	None	None	None	None	None
	Run 3	Run 11	Run 19	Run 4	Run 12	Run 20
Added H_2O, ppm	1267	792	1034	1112	1081	1337
Metal Strip Immersion	Half	Half	Half	Half	Half	Half
System Weight Change, mg	-2.8	-5.1	-6.4	-157.3	-191.0	-402.8*
52100 Steel Strip Weight Change, mg	0	-0.4	-0.3	-0.1	-0.4	-0.7
Degree of Corrosion	None	None	None	None	None	None
	Run 5	Run 13	Run 21	Run 6	Run 14	Run 22
Added H_2O, ppm	0	0	0	0	0	0
Metal Strip Immersion	Total	Total	Total	Total	Total	Total
System Weight Change, mg	+3.0	-2.7	+5.7	-151.4	-146.2	-139.2
52100 Steel Strip Weight Change, mg	0	-0.3	+1.5	-0.5	-0.6	-0.7
Degree of Corrosion	None	None	None	None	None	None

TABLE 3. RESULTS OF CORROSION TESTS WITH MIL-H-6083
AFTER 500 HOURS (CONTINUED)

Property	Run 7	Run 15	Run 23	Run 8	Run 16	Run 24
Added H_2O, ppm	885	877	974	999	1021	1098
Metal Strip Immersion	Total	Total	Total	Total	Total	Total
System Weight Change, mg	-5.0	-5.1	+0.1	-157.7	-162.9	-162.3
52100 Steel Strip Weight Change, mg	0	-0.3	-0.4	-0.5	-0.8	-0.8
Degree of Corrosion	None	None	None	None	None	None

*Glass vial broke at neck during test.

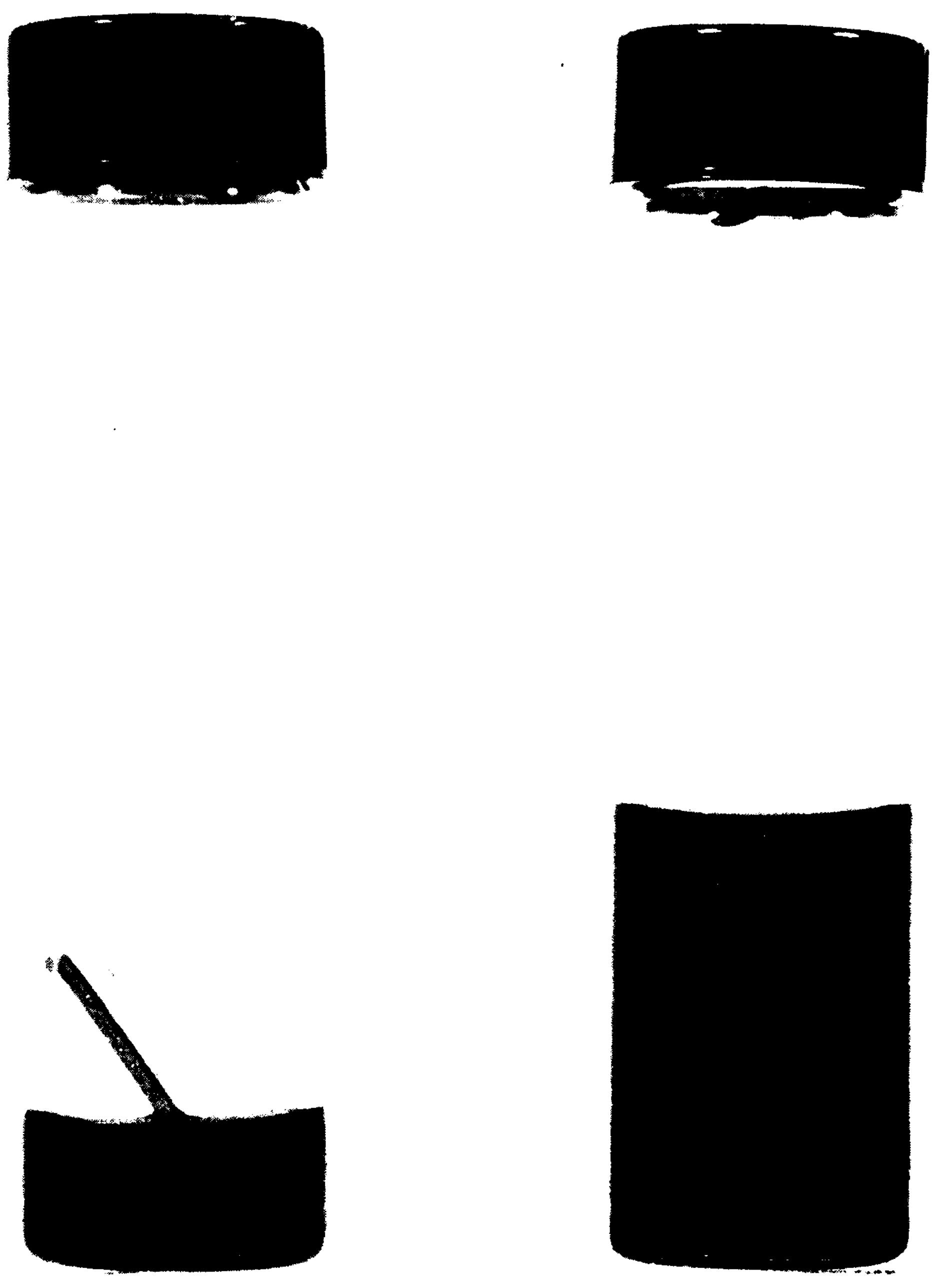

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FIGURE 1. Corrosion Test System

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